#4479

JPARK

Joint Posterior Revision of NLP Annotations via Ontological Knowledge

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FONDAZIONE BRUNO KESSLER

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Sweden

Context: Knowledge Extraction

Kia has hired Peter Schreyer as chief design officer.

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Organization

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NLP Tasks:
- Named Entity Recognition and Classification (NERC)

Context: Knowledge Extraction

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dbpedia:Kia_Motors

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NLP Tasks:
- Named Entity Recognition and Classification (NERC)
- Entity Linking (EL)

Context: Knowledge Extraction

NLP Tasks:
- Named Entity Recognition and Classification (NERC)
- Entity Linking (EL)
- Semantic Role Labeling (SRL)

...

Motivating Examples

Mr. Washington was runner-up at Wimbledon in 1996.

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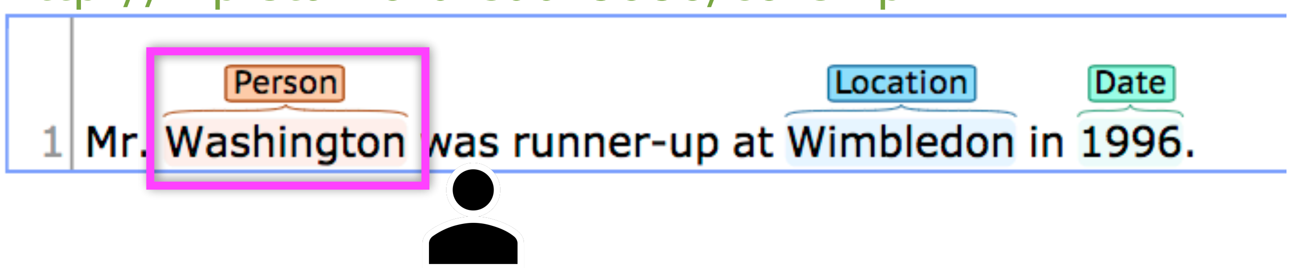
Stanford CoreNLP

http://nlp.stanford.edu:8080/corenlp



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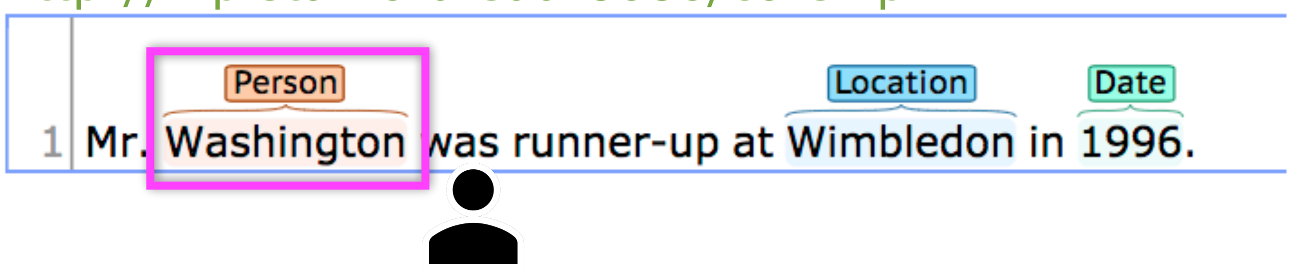

DBpedia Spotlight

http://demo.dbpedia-spotlight.org

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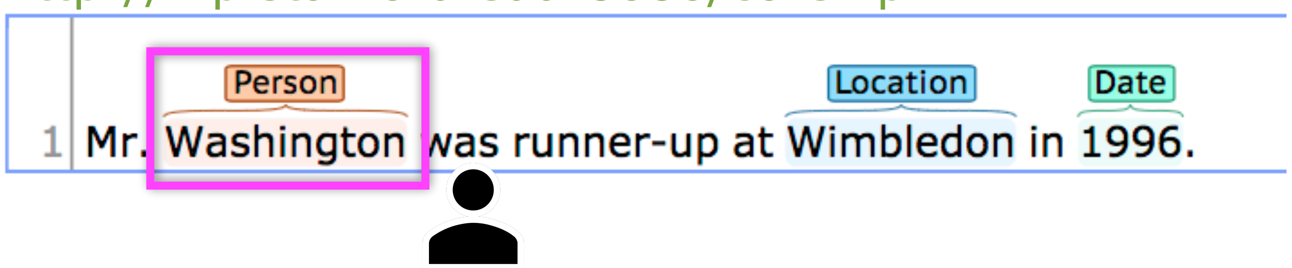

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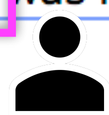

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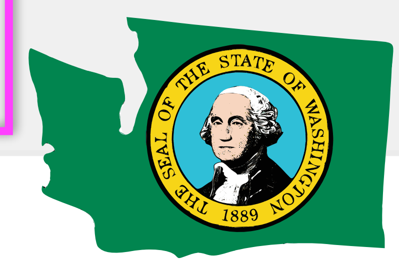

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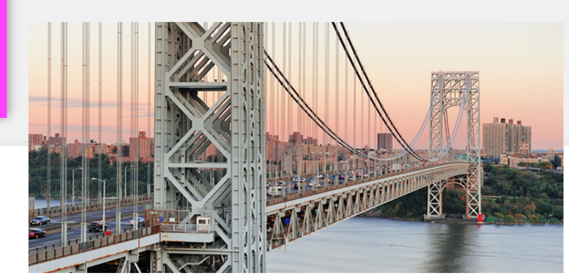

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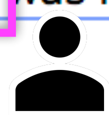

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Org

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Abstracting

… $token_1$ $token_2$ $token_3$ $token_4$ $token_5$ $token_6$ ….

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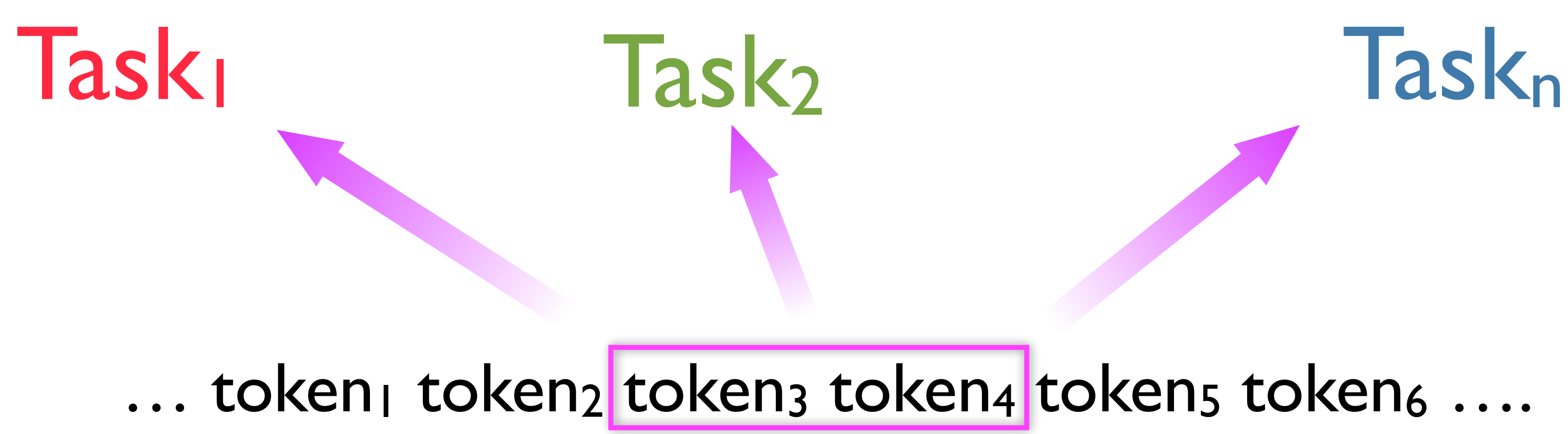
… token_1 token_2 $\boxed{\text{token}_3\ \text{token}_4}$ token_5 token_6 ….

Abstracting



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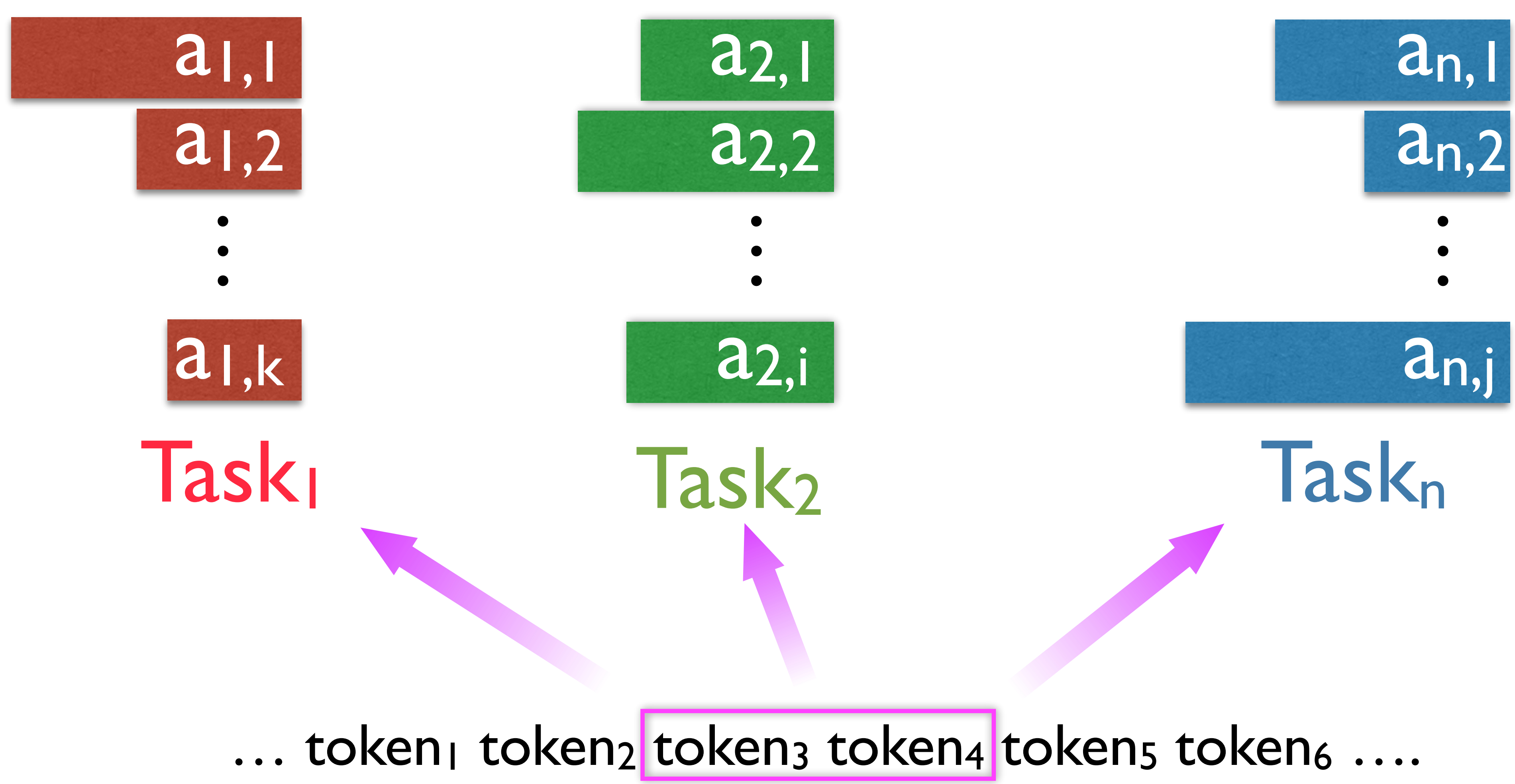

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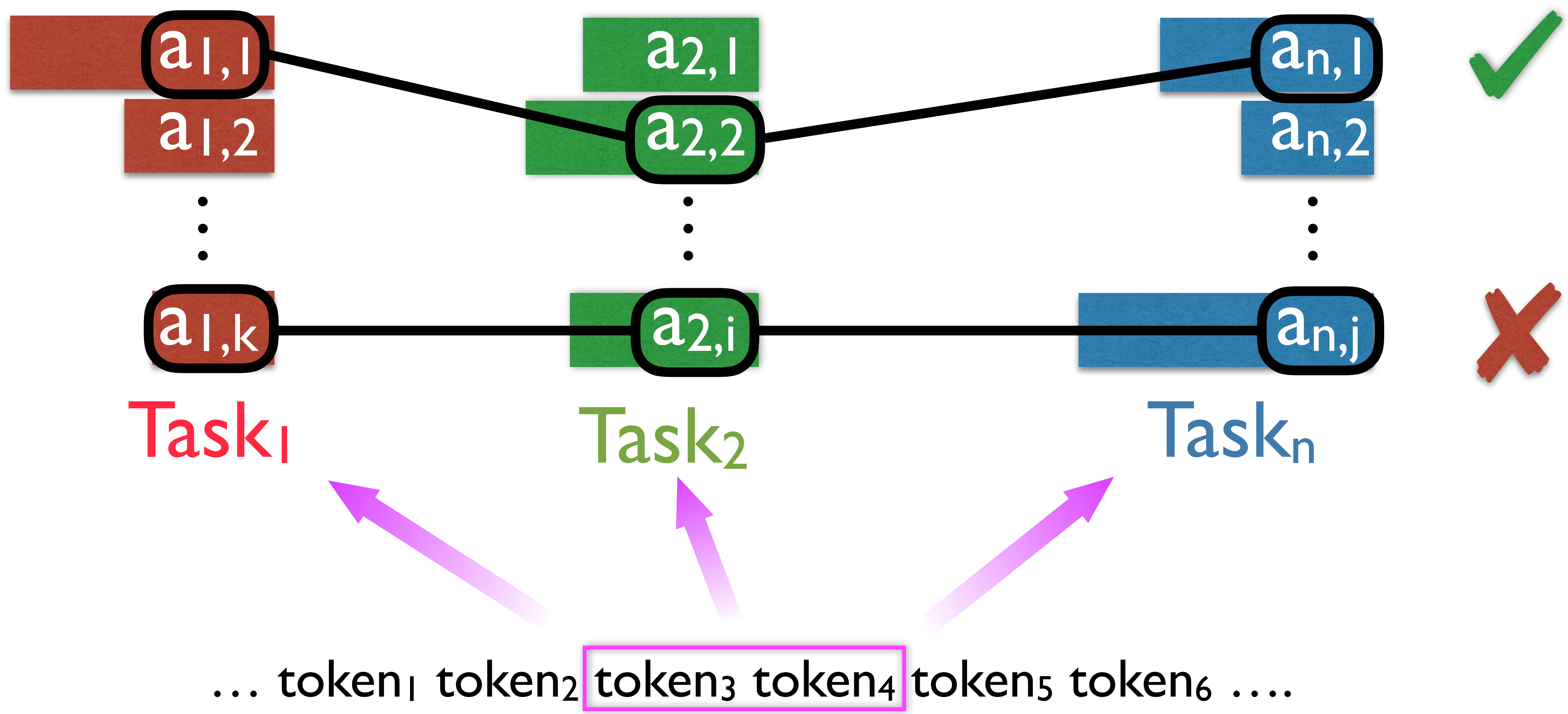

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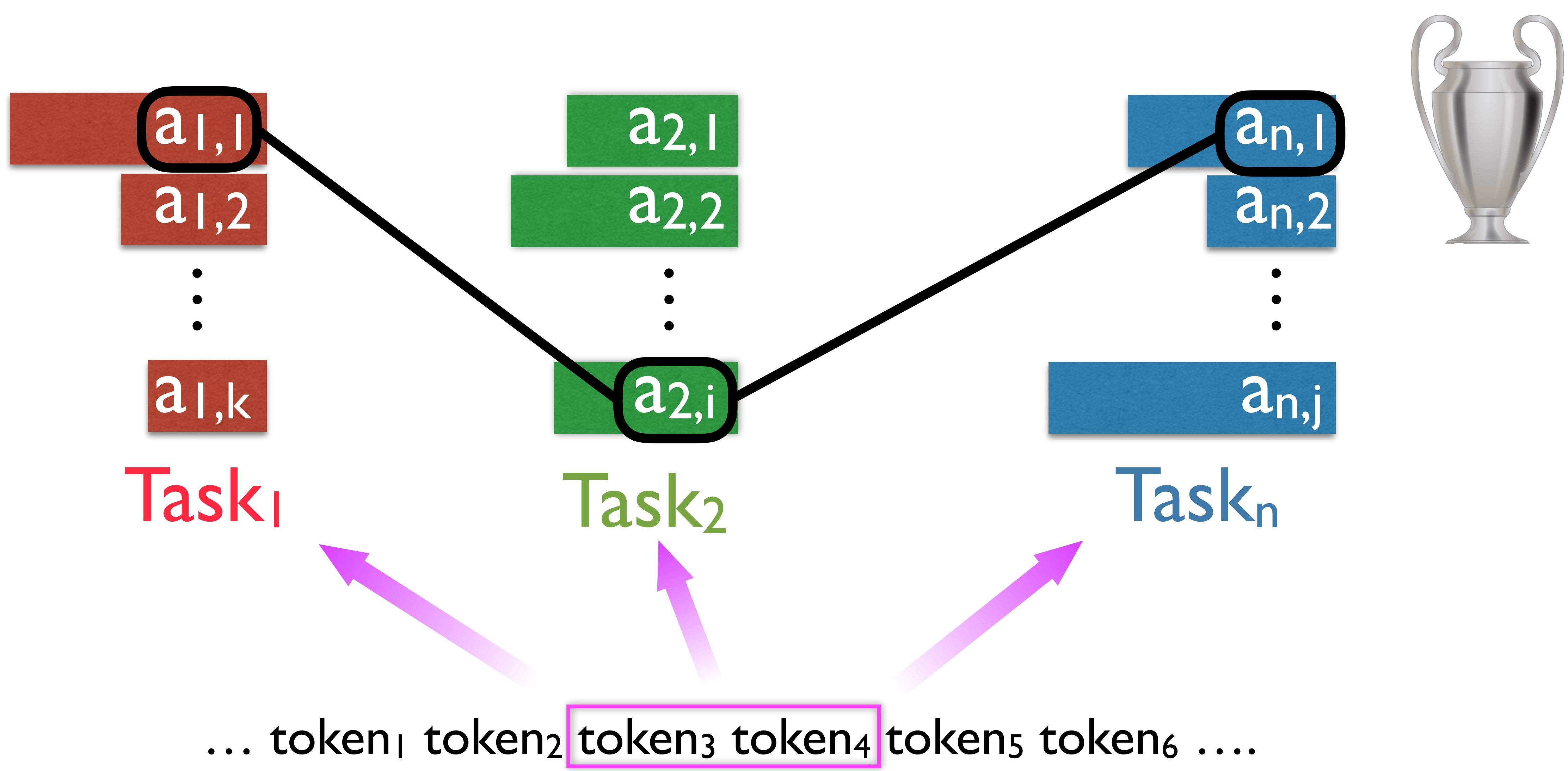
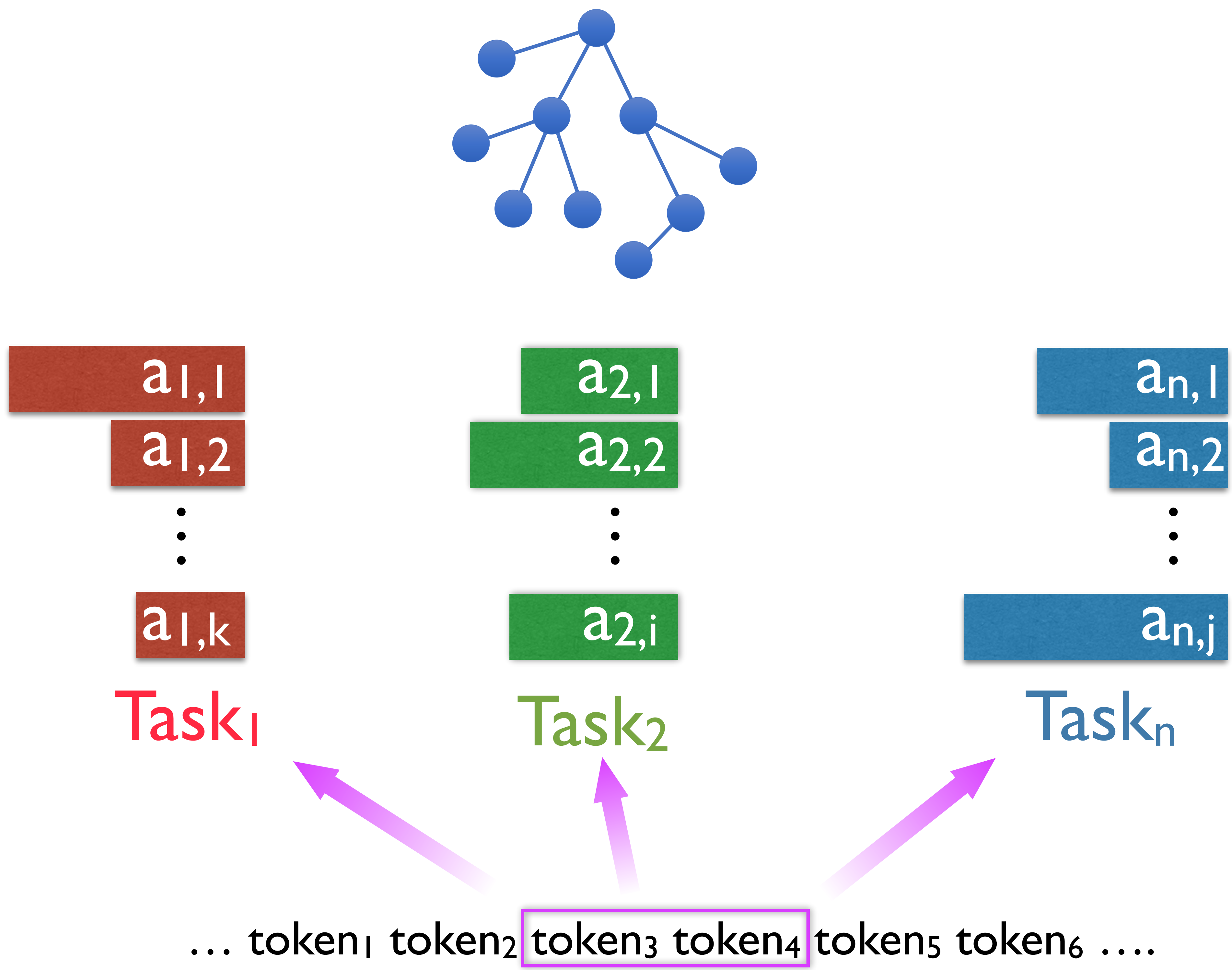


RESEARCH PROBLEM

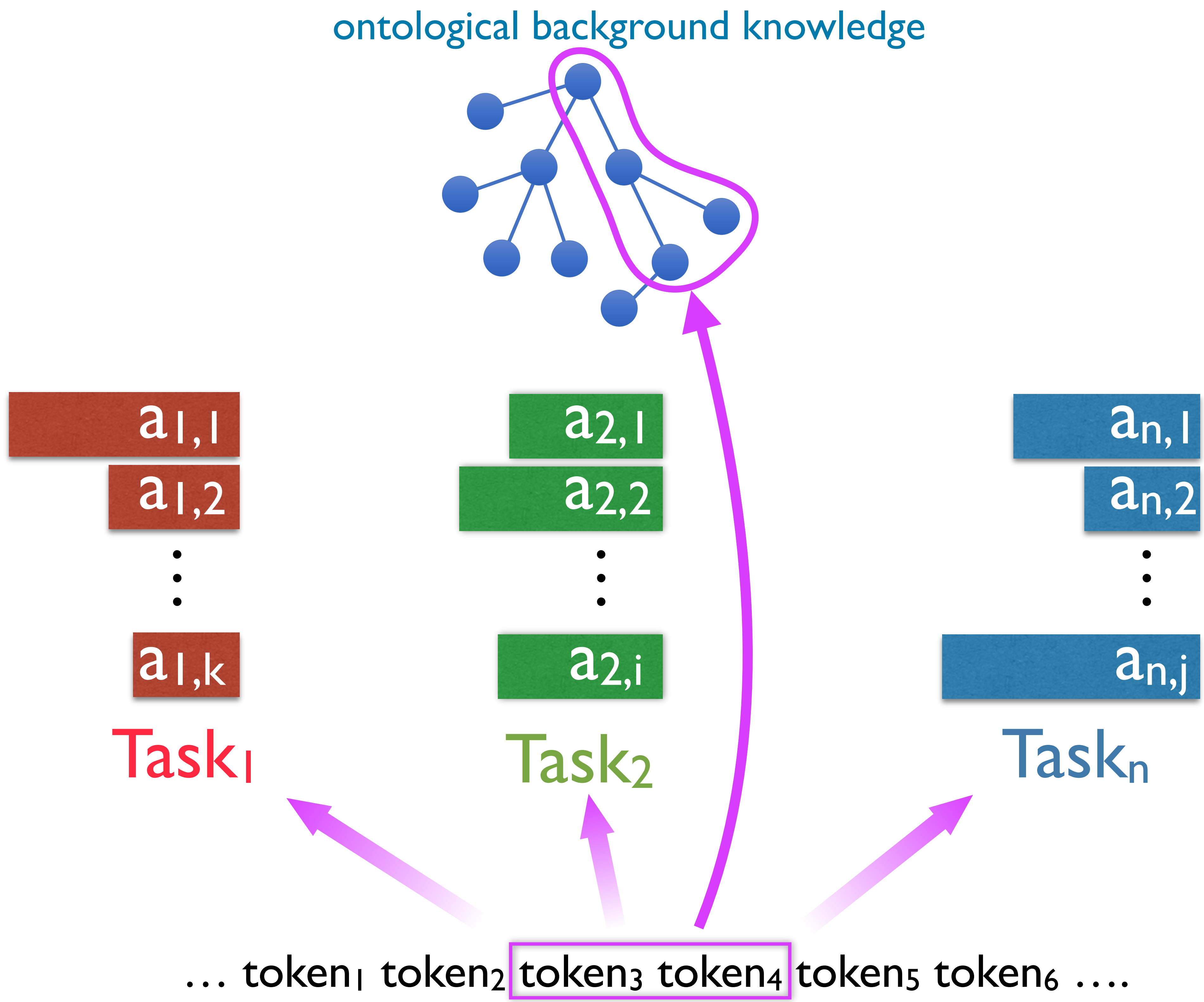
How can we assess and improve the coherence of the various NLP annotations on an entity mention?

In a nutshell

ontological background knowledge



In a nutshell



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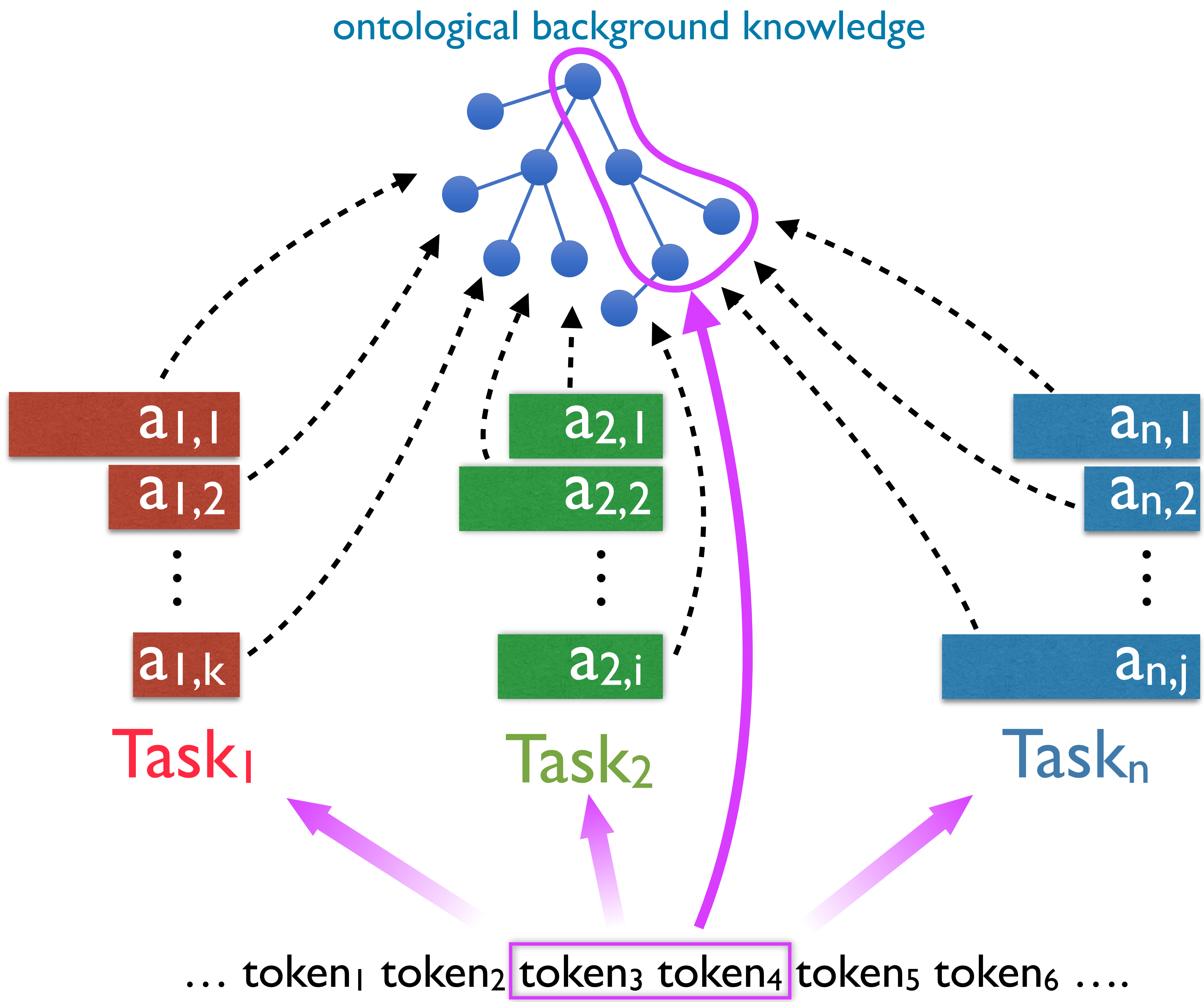

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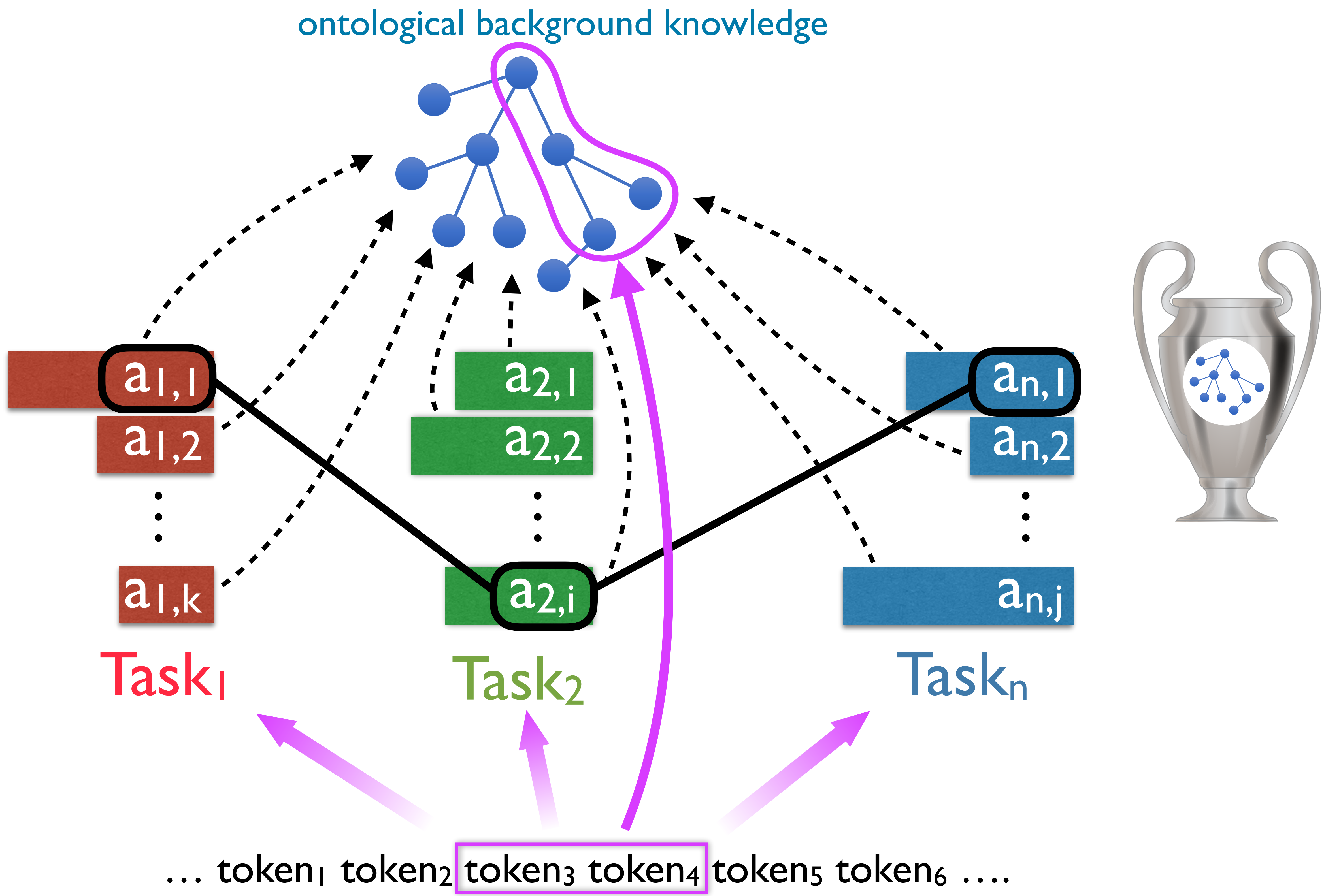

Contributions

1. JPARK: a probabilistic model capable to estimate a posteriori the overall confidence of NLP annotations

2. A concrete instantiation of the model for NERC and EL (using YAGO as ontological knowledge)

3. Application of the NERC and EL model to revise the annotations of Stanford NER and DBpedia Spotlight

JPARK

The JPARK Model

$$\mathrm{P}\left(\boldsymbol{a} \,\middle|\, m, B, K\right)$$

The JPARK Model

entity mention

NLP Background Knowledge

$(a_i, \ldots, a_n)$ NLP Annotations

"The" Ontological Knowledge

$$\mathrm{P}\left(\boldsymbol{a} \,|\, m, B, K\right)$$

The JPARK Model

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$$\mathrm{P}\left(\boldsymbol{a} \,|\, m, B, K\right)$$

set of classes from K

$$\mathrm{P}\left(\boldsymbol{a}, C \,|\, m, B, K\right)$$

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$$\mathrm{P}\left(\boldsymbol{a}, C \,|\, m, B, K\right)$$

$$\mathrm{P}\left(a_i \,|\, m, B\right) \qquad \mathrm{P}\left(C \,|\, a_i, K\right)$$

The JPARK Model

entity mention

NLP Background Knowledge

$(a_i, \ldots, a_n)$ NLP Annotations

"The" Ontological Knowledge

$$\mathrm{P}\left(\boldsymbol{a} \mid m, B, K\right)$$

set of classes from K

$$\mathrm{P}\left(\boldsymbol{a}, C \mid m, B, K\right)$$

confidence score

$$\boxed{\mathrm{P}\left(a_i \mid m, B\right)} \qquad \mathrm{P}\left(C \mid a_i, K\right)$$

The JPARK Model

entity mention

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$$\mathrm{P}\left(\boldsymbol{a}, C \mid m, B, K\right)$$

confidence score

$$\boxed{\mathrm{P}\left(a_i \mid m, B\right)}$$

learned from data

$$\boxed{\mathrm{P}\left(C \mid a_i, K\right)}$$

The JPARK Model

entity mention

NLP Background Knowledge

$(a_i, \ldots, a_n)$ NLP Annotations

"The" Ontological Knowledge

 $= \arg\max_{\boldsymbol{a}} \; \mathrm{P}\left(\boldsymbol{a} \,|\, m, B, K\right)$

set of classes from K

$$\mathrm{P}\left(\boldsymbol{a}, C \,|\, m, B, K\right)$$

confidence score

$$\boxed{\mathrm{P}\left(a_i \,|\, m, B\right)}$$

learned from data

$$\boxed{\mathrm{P}\left(C \,|\, a_i, K\right)}$$

NERC and EL Model

Ingredients

- Ontological Knowledge
- Estimating $\mathrm{P}\left(C \middle| a_{\mathrm{NERC}}, K\right)$
- Estimating $\mathrm{P}\left(C \middle| a_{\mathrm{EL}}, K\right)$

Ingredients

- Ontological Knowledge yago select knowledge

- Estimating $\mathrm{P}\left(C \,|\, a_{\mathrm{NERC}}, K\right)$

- Estimating $\mathrm{P}\left(C \,|\, a_{\mathrm{EL}}, K\right)$

Ingredients

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- Estimating $\mathrm{P}\left(C \,|\, a_{\mathrm{NERC}}\,, K\right)$

  Leverage a gold standard corpus G annotated with NERC types and ontological classes (or EL annotations)

- Estimating $\mathrm{P}\left(C \,|\, a_{\mathrm{EL}}\,, K\right)$

Ingredients

- Ontological Knowledge yago select knowledge

co-occurences

- Estimating $\mathrm{P}\left(C \,|\, a_{\mathrm{NERC}}, K\right) \simeq \dfrac{\boxed{n_G(C, a_{\mathrm{NERC}})}}{\sum_{\mathbb{C}} n_G(\mathbb{C}, a_{\mathrm{NERC}})}$

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  Leverage a gold standard corpus G annotated with NERC types and ontological classes (or EL annotations)

- Estimating $\mathrm{P}\left(C \,|\, a_{\mathrm{EL}}\,,\, K\right)$

  Leverage alignments between EL Knowledge Base and yago select knowledge

Ingredients

- Ontological Knowledge yago select knowledge

co-occurences

- Estimating $\mathrm{P}\left(C \,|\, a_{\mathrm{NERC}}\,, K\right) \simeq \dfrac{\boxed{n_G(C\,,\, a_{\mathrm{NERC}})}}{\sum_{\mathbb{C}} n_G(\mathbb{C}\,,\, a_{\mathrm{NERC}})}$

  Leverage a **gold standard corpus** G annotated with NERC types and ontological classes (or EL annotations)

- Estimating $\mathrm{P}\left(C \,|\, a_{\mathrm{EL}}\,, K\right) \begin{cases} 1 & \text{entity } a_{\mathrm{EL}} \text{ is instance of } C \\ 0 & \text{otherwise} \end{cases}$

  Leverage **alignments** between EL Knowledge Base and yago select knowledge

Application and Evaluation

Tools

- NERC: **Stanford CoreNLP** [Finkel et al., 2005]
- EL: DBpediaSpotlight [Daiber et al., 2013]

NERC+EL Datasets

- AIDA CoNLL-YAGO [Hoffart et al., 2011]
- MEANTIME [Minard et al., 2016]
- TAC-KBP [Ji et al., 2011]

Research Question

Does the JPARK posteriori joint revision of the annotations from Stanford NER and DBpedia Spotlight, via YAGO, improve their NERC and EL performances?

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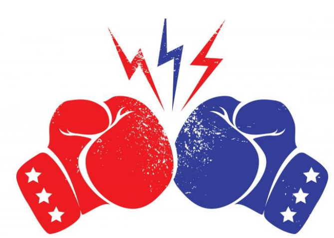

JPARK
Stanford CoreNLP
DBpedia Spotlight

Results

	NERC			EL			NERC+EL		
	P	R	F_1	P	R	F_1	P	R	F_1
AIDA									
standard	94.30%	87.50%	90.80%	66.20%	65.20%	65.60%	63.40%	62.50%	63.00%
with JPARK	95.00%	88.10%	91.40%	67.10%	65.40%	66.20%	65.50%	63.70%	64.60%
Δ	**0.70%**	**0.60%**	**0.60%**	**0.90%**	**0.20%**	**0.60%**	**2.10%**	**1.20%**	**1.60%**
MEANTIME									
standard	88.20%	69.50%	77.70%	70.30%	55.60%	62.10%	63.50%	50.20%	56.10%
with JPARK	91.40%	72.00%	80.50%	70.50%	55.70%	62.20%	67.00%	53.00%	59.20%
Δ	**3.20%**	**2.50%**	**2.80%**	0.20%	0.10%	0.10%	**3.50%**	**2.80%**	**3.10%**
TAC-KBP									
standard	91.10%	65.20%	76.00%	40.10%	42.30%	41.20%	36.70%	38.60%	37.60%
with JPARK	92.60%	66.30%	77.20%	41.20%	42.60%	41.90%	38.90%	40.20%	39.50%
Δ	**1.50%**	**1.10%**	**1.20%**	**1.10%**	0.30%	**0.70%**	**2.20%**	**1.60%**	**1.90%**

Bold = statistical significant (approx. rand. test)

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Conclusions

- Novel probabilistic model, leveraging ontological knowledge, for improving NLP entity annotations
- Instantiation of the model for the NERC and EL tasks
- Empirical confirmation (3 datasets) of the capability of the model to improve the quality of the annotations

- Future Work: extension to other tasks (e.g., SRL)

JPARK
pikes.fbk.eu/jpark

KE4IR
pikes.fbk.eu/ke4ir

KnowledgeStore
knowledgestore.fbk.eu

RDFpro
rdfpro.fbk.eu

PSL4EA
pikes.fbk.eu/psl4ea

PIKES
pikes.fbk.eu

Marco Rospocher

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dkm.fbk.eu/rospocher
@marcorospocher

BPMN Ontology
dkm.fbk.eu/bpmn-ontology

PESCaDO
bit.ly/pescado-onto

NewsReader
POST HOC ERGO PROPTER HOC
Event & Situation Ontology
github.com/newsreader/eso

PREMON
premon.fbk.eu

MoKi
the Modelling WiKi ---
moki.fbk.eu

TeX-Owl
github.com/dkmfbk/TexOwl